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ABUNDANCE OF FRUGIVOROUS BIRDS AND RICHNESS OF FRUIT RESOURCE: IS THERE A TEMPORAL RELATIONSHIP?

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Abstract

It is believed that the abundance of frugivorous birds in a landscape is related to the fruit supply in each vegetation type. Although some evidence for this relationship exists at the bird community level, it has seldom been demonstrated in frugivorous bird species that inhabit different vegetation types or succesional gradients in a landscape. In this study, I assessed the temporal relationships between the abundance of individual frugivorous bird species and the richness of fruiting ornithochorous plant species in different, contiguous vegetation types in a neotropical landscape. Monthly variation in abundance of each frugivorous bird species cannot be explained by the richness of fruiting ornithochorous plant species in each vegetation type. I found only two positive correlations out of a possible 42 (fourteen bird species in three vegetation types), which could easily be due to chance. In studies of this type, it is possible to obtain different results if the variables are absolute abundance of fruit (e.g., number of ripe fruits in an area) or richness or abundance of specific plant species eaten by each bird species assessed, instead of richness of fruiting ornithochorous plant species by vegetation type.

Key words: Frugivorous birds, landscape, ornithochorous plants, vegetation type.

Resumen

Se cree que la abundancia de las aves frugívoras en diferentes parches de un paisaje está relacionada con la riqueza del recurso fruto. Aunque existe evidencia a nivel de comunidad, esta relación pocas veces ha sido probada cuantitativamente a nivel de especie para aves frugívoras que habitan diferentes tipos de vegetación o etapas sucesionales en un paisaje. En este trabajo evalué, en un paisaje neotropical, la relación mensual entre abundancia de especies de aves frugívoras y riqueza del recurso fruto en diferentes tipos de vegetación contiguos. La abundancia mensual de cada especie de ave frugívora no se puede explicar en función de la riqueza de las especies de plantas ornitócoras en fruto por tipo de vegetación. Sólo encontré dos correlaciones positivas de las 42 realizadas (catorce especies de aves por tres tipos de vegetación), lo cual bien podría ser resultado del azar. En estudios de este tipo es posible que se obtenga otro resultado al considerar variables como la abundancia absoluta del recurso fruto (*v. gr.,* número de frutos maduros disponibles en un área) o la riqueza o abundancia de las especies específicas de las que se alimenta cada especie de ave, en vez de la riqueza del recurso por de tipo de vegetación.

Palabras clave: Aves frugívoras, paisaje, plantas ornitócoras, tipo de vegetación.

Introduction

The abundance of frugivorous birds is hypothesized to be positively related to the supply of fruit resources (Karr 1976, Wheelwright 1983, Blake & Loiselle 1991, Loiselle & Blake 1991, Levey & Stiles 1992). This relationship has been found to exist between communities of frugivorous birds and the abundance of ripe fruit in particular vegetation types, but it has been found in few particular frugivorous bird species within those communities (e.g., Loiselle & Blake 1991, Rey 1995, Herrera 1998). Of two different studies in a tropical rain forests in Costa Rica, there is evidence that abundance of a community of frugivorous birds is correlated on both spatial and temporal scales with the abundance of fruit resources within different vegetation types (Levey 1988, Loiselle & Blake 1991).

If bird abundance is related to fruit abundance within a vegetation type at the community level, then one would expect that abundance of individual bird species within that community is also related to other measures of fruit abundance as richness of ornithochorous plants. Several studies have examined the presence or abundance of particular frugivorous bird species in relation to fruit availability in different vegetation types in a landscape (e.g., Davies 1945, Wheelwright 1983, Murray 1988, Herrera 1985), but few of these studies quantified the relationship (e.g., Loiselle & Blake 1993, Rey 1995, Herrera 1998; see Hutto 1990, Jordano 1992 for reviews). Lack of quantitative studies may be because this relationship between individual species and fruit does not exist or because such a relationship is difficult to detect.

In this study, I addressed the hypothesis that monthly number of individuals of each frugivorous bird species (abundance) is related to monthly richness of ornithochorous plant species. To test this hypothesis, I determined monthly abundance of common frugivorous bird species inhabiting three different vegetation types within the Gulf of Mexico coastal region and compared bird abundance in relation to monthly richness of ornithocorous plant species in each vegetation type.

Study Site

Field work was carried out at the Centro de Investigaciones Costeras La Mancha (CICOLMA), located in the central coastal plain of Veracruz, Mexico (19° 36' N, 96° 22' W; 100 m above sea level). The mean annual temperature is 22.9° C, maximum extreme 33.3° C and minimum extreme 12.1° C. Annual precipitation varies between 900-1800 mm, with a dry season between October and May (Moreno-Casasola 1982, Blain 1988).

Two hundred and sixty-three bird species have been recorded at CICOLMA (Ortiz-Pulido et al. 1995, Ortiz-Pulido et al. in press), and another 35 species that have not yet been reported in the reserve itself are known from the surrounding region (López-Portillo et al. 1993, Alvarez 1994). Birds that feed on invertebrates are the most common in this area (84% of the species) while 36% of species feed on fruits and 35% include vertebrates in their diet (Ortiz-Pulido et al. 1995).

In this reserve there are more than 70 plant species whose fruits have ornithochorous characteristics (e.g., red, black or purple skin with aril or pulp, *sensu* Van der Pijl 1972 and Howe & Westley 1988) but birds are known to eat the fruits of only 33 of these (Ortiz-Pulido 1994). These plants are found in seven vegetation types (sensu Novelo 1978): shrubs on sand dunes, pastures with isolated standing trees, tropical dry forest, mangroves, tropical deciduous forest, flooded forest, and field crops. This study was limited to the first three of these -shrubs, pastures, and dry forest- because they comprise the largest part of the vegetation in CICOLMA (except for mangrove). Frugivorous birds cross the vegetation boundaries regularly such that abundance patterns of these birds could reflect potential habitat quality (Ortiz-Pulido 1997, Ortiz-Pulido et al. in press). Over this landscape on a community level, richness of frugivorous birds and ornithochorous plants are related on a monthly basis (Ortiz-Pulido et al. in press).

Methods

To assess the abundance of common frugivorous bird species, I walked one transect in one patch of each of the three vegetation types, three or four times per month, from April 1992 to March 1993. Each transect was approximately 1000 m long and I walked at constant speed for a duration of one hour twenty minutes. The three vegetation types were surveyed once per day, changing order on consecutive days, starting from sunrise to 11:00 hours, following Emlen's suggestions (1971, 1977). Survey effort was similar for each vegetation type -about 44 km were walked in each vegetation type each year. For each bird or group of birds seen, I recorded species, number of individuals, and perpendicular distance to the transect. I did not register flying birds and excluded rainy or windy days. In order to reduce bias because of different detectability in each vegetation type (e.g., in grassland a bird can be seen up to 500 m away but in dry forest rarely further than 20 m), I also excluded every bird observed more than 20 m from me. I considered a bird species to be common if I recorded it 40 or more times, and frugivorous if I saw it eating fruits during this study. I considered the total number of monthly records of each bird species in a vegetation type as a measure of the monthly abundance of each species in this particular vegetation. The monthly richness reported here takes into account only the common frugivorous species; the monthly richness of the bird community is different and can be found elsewhere (Ortiz-Pulido 1994). Scientific and common names are reported following AOU (1998) and status and feeding guild following Ortiz-Pulido et al. (1995).

To determine the monthly richness of ornithochorous plant species with ripe fruit, I collected, in each transect (20 m to each side), the plant species with ripe fruits with ornithochorous characteristics (*sensu* Howe & Westley 1988) that I saw being eaten by birds. The systematic method used to detect these plants (census and focal observations) and an estimate of missing frugivorous-ornithochorous interactions in each vegetation type (between 0-20%, depending on the analysis used) can be checked elsewhere (Ortiz-Pulido 1994, Ortiz-Pulido et al. in press). For each plant collected, I recorded the date, vegetation type, and exact collecting site. Individual plants were deposited and identified in Herbarium of the Instituto de Ecologia, A.C., Xalapa, Veracruz (XAL). Scientific names are reported following Sosa & Gómez-Pompa (1994). I considered the monthly total number of plant species with ripe fruit in a vegetation type as the ornithochorous monthly richness of this vegetation.

To determine the monthly relationship in each vegetation type between abundance of each bird species and richness of ornithochorous plants, I performed Spearman rank correlations (r_s). I did not test to detect temporal autocorrelation of the two assessed variables (Verdú y García-Fayos 1994) because the result did not merit it (see below). Tests of temporal autocorrelation must be done when significant correlations are found.

Results

I recorded fourteen common frugivorous bird species in 180 hours of field work. All occurred in all three vegetation types. In shrubs I recorded 321 frugivorous birds, in pastures 300, and in dry forest 461. Monthly number of records by bird species are shown in Appendix 1. Golden-fronted Woodpecker (*Melanerpes aurifrons*) and Social Flycatcher (*Myiozetetes similis*) were the most common species in all vegetation types. Also common in shrubs were Northern Mockingbird (*Mimus polyglottos*), in pastures Melodious Blackbird (*Dives dives*), and in dry forest Brown Jay (*Cyanocorax morio*), Montezuna Oropendola (*Psarocolius montezuma*), Black-headed Trogon (*Trogon melanocephalus*), and Scissor-tailed Flycatcher (*Tyrannus forficatus*). In shrubs I recorded an average of 6.3 ± 0.7 bird species per month, in pastures 5.1 ± 0.5, and in dry forest 7.0 ± 0.8. Bird diversity was highest in shrubs in April and August (nine species), in pastures in September (eight species) and in dry forest in February, March, and May (ten species).

I collected 77 plant species with ornithochorous characteristics. I recorded 27 species with ripe fruits in shrubs, 18 in pastures and 60 in dry forest. Months in which each plant species was recorded are found in Appendix 2. On average 7 ± 1.1 species had ripe fruits in shrubs during anyone month, 3 ± 0.4 in pastures, and 11 ± 0.6 in dry forest. Months with higher richness were February and November in shrubs (twelve species), May (five) in pastures, and August (fourteen) in dry forest.

Two combinations, out of 42 tested, of abundance of particular frugivorous bird species and richness of fruiting ornithochorous plants species, showed significant correlations. Northern Mockingbird was significantly related to fruit species richness in shrub habitat ($rs = 0.84$, $p < 0.001$) as was Golden-fronted Woodpecker in pastures ($rs = 0.60$, $p < 0.05$). Any other data processing (e.g., dephasing data series one or two months earlier, or taking into account only plant species whose fruits are reported as ingested by birds in these landscapes) gave a similar result (i.e., zero or three significant correlations among the 42 combinations).

Discussion

Monthly abundance of the most common frugivorous birds species inhabiting the vegetation types studied cannot be explained as a function of the richness of fruiting ornithochorous plant species within a vegetation type. In this study, only two bird species showed significant correlations with richness of fruiting plants, and these correlations can be explained by chance. To the best of my knowledge, only three studies have reported significant correlations between the abundance of frugivorous bird species and some measure of fruit availability (Wheelwright 1983, Rey 1995, Herrera 1998). However, two of these studies treated the same species, *Sylvia atricapilla* of Eurasia, thus precluding broader conclusions. Of five similar studies conducted at the community level, two found no relationship between abundance of frugivorous birds and richness of fruiting ornithochorous plants (Levey 1988, Herrera 1998), one found that a relationship did exist (Blake & Loiselle 1991, Loiselle & Blake 1991), while the last two assumed it, but did not test it statistically (Thompson & Willson 1979, Wong 1986).

It could be argued that richness of fruiting plants is not the best variable to use, as it prevents detection of other kinds of relationships between the two groups of organisms, but it is not clear what other variables would be more suitable (see Hutto 1990). For example, when abundance of individuals in a community of frugivorous birds was examined for correlation with the abundance of fruiting ornithochorous plants, no clear relationship was found. In two different studies (Levey 1988, Loiselle & Blake 1991) where the abundance of three of four frugivorous groups were related to abundance of ripe ornithochorous fruits in three vegetation types, less than 22% of the combinations tested were significantly correlated. In another study Loiselle & Blake (1993) obtained a similar result (13% of positive significant correlations) when they looked for a relationship between the abundance of five frugivorous bird species and three fruiting plant species eaten by these birds. However, when they tried to find a correlation between each bird and plant species studied, they found 0.003% of significant correlations. Something similar was found by Herrera (1998), who detected only one significant correlation out of 112 made between Mediterranean bird and plant species. At the community level, it is possible that abundance of bird species may be better related to the absolute number of fruits available in a vegetation type than other variables. The results obtained by Loiselle & Blake (1991) and Blake & Loiselle (1991), where three or four of nine correlations were significant, and those of Verdú & García-Fayos (1994), where only one correlation was significant, support this possibility. For individual bird species, this possibility remains to be tested at the landscape level more broadly, i.e., considering different vegetation types. It is also possible that a relationship may be found between individual bird species and fruiting ornithochorous plants if the abundance of plant species ingested by a particular bird species is considered, as had been proved for *Turdus philomelos* (Rey 1995), *Sylvia atricapilla* (Rey 1995, Herrera 1998), and, partially, for *Pharomachrus mocinno* (Wheelwright 1983). However, this relationship remains generally unexplored, possibly because of a lack of knowledge about the natural history of many frugivorous-ornithochorous systems (Blake et al. 1990).

In addition to the other alternatives mentioned, the lack of observed patterns with this set of bird species may reflect their ability to use alternative food sources. None of the species listed in Appendix 1, even the Olive-throated Parakeet (*Aratinga nana*), are strictly frugivorous in the zone (Ortiz-Pulido et al. 1995, Ortiz-Pulido, unpublished data). The lack of patterns may reflect the need to include all food resources used by the bird species. In other words, a more general hypothesis may be true, i.e., food resources explain bird abundance, but the pattern was not detected because I used only fruit resources as the predictor variable. In the zone the studied frugivorous bird species eat the fruits of three to twelve plant species ($\bar{x} = 6.8$), and ten of these bird species are included amung the twelve most frugivorous birds in this landscape (Ortiz-Pulido et al. in press).

In this study, the evidence did not support the hypothesis of a positive relationship between the abundance of particular frugivorous bird species and the richness of fruiting ornithochorous plants within three vegetation types. Rare cases (two of 42 combinations tested), where a positive significant correlation was found can be explained as a result of chance. Even though my results are based on a tiny sample size (one transect walked three or four times by month in each vegetation type), my conclusions are supported by the lack of patterns found in other studies.

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APPENDIX 1. Number of frugivorous birds registered per species per month in three vegetation types in CICOLMA, Veracruz, Mex.

	MONTH											
	A	M	J	J	A	S	O	N	D	J	F	M
VEGETATION TYPE	SHRUBS											
SPECIES												
Columba flavirostris	5			4	2	2			1			
Aratinga nana	2				2	1				4		
Tyrannus forficatus						1					1	2
Trogon melanocephalus			1		1		1					1
Melanerpes aurifrons	1			6	6	3	3	6	1	2	4	
Pitangus sulphuratus	1		5	1	2	4	7	5		1		
Myiozetetes similis	5		8		3	7	2	27	11	19		7
Tityra semifasciata							2	5	3	1		
Cyanocorax morio	2		1		1		3			2	3	1
Mimus polyglottos								22	6	9	8	3
Dives dives	2			3	11			4				4
Icterus gularis	2		1	7				2				3
Icterus galbula					9	15		2		1		1
Psarocolius montezuma	3								1			
Register \ month	23	0	16	21	37	33	18	73	23	39	16	22
Species \ month	9	0	5	5	9	7	6	8	6	8	4	8
VEGETATION TYPE	PASTURES											
SPECIES												
Columba flavirostris	3		4								3	
Aratinga nana						2	6			9	2	2
Tyrannus forficatus	26					2						
Trogon melanocephalus												
Melanerpes aurifrons	4	6	4	7	9	5	1	3	2	1	4	6
Pitangus sulphuratus		1	2	1	2		1	1		1		
Myiozetetes similis	11	11	6	11	4			1	4	2		
Tityra semifasciata		1										
Cyanocorax morio	1			4	1	1		10	7		1	

APPENDIX 1. Continued.

	MONTH											
	A	M	J	J	A	S	O	N	D	J	F	M
Mimus polyglottos												
Dives dives	1	11	6	7	5	15	9					
Icterus gularis		7	1			20						
Icterus galbula						10						
Psarocolius montezuma	5			1		2				2	2	
Register \ month	51	37	23	31	21	57	17	15	13	15	12	8
Species \ month	7	6	6	6	5	8	4	4	3	5	5	2
VEGETATION TYPE	DRY FOREST											
SPECIES												
Columba flavirostris	10										7	
Aratinga nana									2	4	14	7
Tyrannus forficatus	37					1						1
Trogon melanocephalus	6	1	3					2		1	7	17
Melanerpes aurifrons	3	9	9		7	2	2	1	5	8	14	7
Pitangus sulphuratus		4	3		1		3	3		5	2	1
Myiozetetes similis		1				3	9	6		18	2	4
Tityra semifasciata		5	3			1	1	3	4	7	1	3
Cyanocorax morio	3	17	7		3	3	5	4			11	8
Mimus polyglottos								1				
Dives dives	8	1	5		2	1	2				3	2
Icterus gularis		2				2				2		
Icterus galbula	3	1				5						
Psarocolius montezuma	10	4	5		1		1		1	3	35	17
Register \ month	83	45	35	0	14	18	23	20	12	48	96	67
Species \ month	8	10	7	0	5	8	7	7	4	8	10	10

APPENDIX 2. Plant species with ornithocorous characteristics fruiting in three vegetation types per month in CICOLMA, Veracruz, Mexico.

	MONTH											
	A	M	J	J	A	S	O	N	D	J	F	M
VEGETATION TYPE	SHRUBS											
SPECIES												
Achatocarpus nigricans												
Annona glabra												
Bromelia pinguin												
Brosimun alicastrum												
Bursera fagaroides		x									x	
Bursera simaruba									x	x	x	x
Cactaceae sp. 1												
Capparis baducca												
Casearia corymbosa				x								
Celastraceae sp. 1						x						
Celtis caudata				x				x	x	x		
Chioccoca alba	x	x							x	x	x	x
Chiococca coriaceae												
Clethra mexicana												
Coccoloba barbadensis								x				x
Cojoba arborea												
Coniza sp. 1					x	x			x			
Cupanea dentata												
Cytharexylum hexangulare												
Dendropanax arboreus												
Desmopsis sp. 1											x	x
Diospyros verae-crucis												
Erithroxylum havanense												
Eugenia acapulcensis												
Euphobiaceae sp. 1												
Ficus cotinifolia												
Ficus obtusifolia											x	
Guetarda elliptica												
Hyperbaena mexicana												
Jacquinia sp. 1												
Karwinskia humboldtiana										x		
Lantana camara							x	x		x	x	x
Malpighia glabra		x	x			x		x				
Manilkara zapote												
Nectandra coriaceae						x						
Oleaceae-Olacaceae sp. 1												
Opuntia stricta		x	x			x	x	x	x	x	x	x
Passiflora sp. 1										x		x
Paullinia sp. 1								x				

APPENDIX 2. Continued.

	MONTH											
	A	M	J	J	A	S	O	N	D	J	F	M
Phoradendron cuadrangulare	x						x	x	x	x	x	x
Piper aequale												
Pithecellobium calostachys												
Pithecellobium sp. 1												
Psittacantus insigne								x	x	x	x	
Psychotria erythrocarpa	x		x	x		x		x			x	x
Racoma sp. 1												x
Randia aculeata	x	x		x				x	x	x	x	x
Randia laetaevirens												
Randia monantha												
Rivinia humilis												
Rosaceae sp. 1												
Rourea glabra												
Sapranthus microcarpus												
Schoeptia achreberi	x	x									x	
Solanum rudepanum												
Stemmadenia galeottianna												
Tabernaemontana alba												
Tabernaemontana sp.1												
Trophis racemosa		x										
Tournefortia sp. 1												
Trichilia sp. 1												
Trichostigma sp. 1												
Tournefortia hirsutissima												
Vitis biformis												
Vitis tiliifolia												
Sp. 1												
Sp. 2												
Sp. 5												
Sp. 6							x					
Sp. 7								x				
Sp. 8												
Sp. 9												
Sp. 10								x				
Sp. 11												
Sp. 12												
Sp. 14												
Sp. 15												
Species / month	5	8	3	4	1	5	5	12	8	10	12	11

APPENDIX 2. Continued.

	MONTH											
	A	M	J	J	A	S	O	N	D	J	F	M
VEGETATION TYPE	PASTURES											
SPECIES												
Achatocarpus nigricans					x							
Annona glabra												
Bromelia pinguin												
Brosimun alicastrum												
Bursera fagaroides												
Bursera simaruba												
Cactaceae sp. 1												
Capparis baducca												
Casearia corymbosa												
Celastraceae sp. 1												
Celtis caudata					x							
Chioccoca alba												
Chiococca coriaceae												
Clethra mexicana				x								
Coccoloba barbadensis												
Cojoba arborea												
Coniza sp. 1												
Cupanea dentata												
Cytharexylum hexangulare												
Dendropanax arboreus												
Desmopsis sp. 1												
Diospyros verae-crucis												
Erithroxylum havanense												
Eugenia acapulcensis												
Euphobiaceae sp. 1												
Ficus cotinifolia												
Ficus obtusifolia												
Guetarda elliptica												
Hyperbaena mexicana												
Jacquinia sp. 1					x							
Karwinskia humboldtiana												
Lantana camara		x	x	x		x			x		x	x
Malpighia glabra		x	x		x	x	x				x	x
Manilkara zapote												
Nectandra coriaceae												
Oleaceae-Olacaceae sp. 1												
Opuntia stricta												
Passiflora sp. 1											x	
Paullinia sp. 1												

APPENDIX 2. Continued.

	MONTH											
	A	M	J	J	A	S	O	N	D	J	F	M
Phoradendron cuadrangulare												
Piper aequale						x						
Pithecellobium calostachys		x	x									
Pithecellobium sp. 1												
Psittacantus insigne												
Psychotria erythrocarpa												
Racoma sp. 1				x			x		x			x
Randia aculeata												
Randia laetaevirens												x
Randia monantha												
Rivinia humilis			x					x				
Rosaceae sp. 1												
Rourea glabra												
Sapranthus microcarpus												
Schoeptia achreberi												
Solanum rudepanum												
Stemmadenia galeottianna												
Tabernaemontana alba												
Tabernaemontana sp.1												
Trophis racemosa												
Tournefortia sp. 1	x											
Trichilia sp. 1												
Trichostigma sp. 1		x										
Tournefortia hirsutissima							x		x			
Vitis biformis												
Vitis tiliifolia												
Sp. 1												
Sp. 2												
Sp. 5												
Sp. 6												
Sp. 7												
Sp. 8											x	
Sp. 9		x										
Sp. 10												
Sp. 11												
Sp. 12	x											
Sp. 14												
Sp. 15												
Species / month	2	5	4	3	4	3	3	1	3	0	4	4

APPENDIX 2. Continued.

	MONTH											
	A	M	J	J	A	S	O	N	D	J	F	M
VEGETATION TYPE	DRY FOREST											
SPECIES												
Achatocarpus nigricans							x					
Annona glabra	x											x
Bromelia pinguin				x								x
Brosimun aliscatrum	x										x	x
Bursera fagaroides												
Bursera simaruba	x						x			x	x	
Cactaceae sp. 1		x										
Capparis baducca		x										
Casearia corymbosa				x	x							
Celastraceae sp. 1												
Celtis caudata					x						x	x
Chioccoca alba							x					
Chiococca coriaceae					x	x						
Clethra mexicana		x	x									
Coccoloba barbadensis		x			x							
Cojoba arborea		x										
Coniza sp. 1												
Cupanea dentata	x											
Cytharexylum hexangulare		x			x	x						
Dendropanax arboreus												x
Desmopsis sp. 1					x		x		x			
Diospyros verae-crucis		x										
Erithroxylum havanense			x									
Eugenia acapulcensis												x
Euphobiaceae sp. 1								x			x	
Ficus cotinifolia	x						x				x	
Ficus obtusifolia	x											
Guetarda elliptica				x								
Hyperbaena mexicana		x										
Jacquinia sp. 1								x	x	x	x	
Karwinskia humboldtiana									x			
Lantana camara												
Malpighia glabra	x	x	x				x	x	x			x
Manilkara zapote								x				
Nectandra coriaceae			x	x	x		x					
Oleaceae-Olacaceae sp. 1					x							
Opuntia stricta												
Passiflora sp. 1								x		x	x	
Paullinia sp. 1												

APPENDIX 2. Continued.

						MONTH						
	A	M	J	J	A	S	O	N	D	J	F	M
Phoradendron cuadrangulare									x			
Piper aequale				x				x	x			
Pithecellobium calostachys												
Pithecellobium sp. 1			x									
Psittacantus insigne									x		x	
Psychotria erythrocarpa	x								x			x
Racoma sp. 1	x	x		x	x	x	x	x	x	x	x	x
Randia aculeata												
Randia laetaevirens												
Randia monantha		x			x	x	x	x	x	x	x	
Rivinia humilis												
Rosaceae sp. 1							x	x	x	x		
Rourea glabra	x											
Sapranthus microcarpus	x											
Schoeptia achreberi												
Solanum rudepanum			x									
Stemmadenia galeottianna			x									
Tabernaemontana alba			x									
Tabernaemontana sp.1					x							
Trophis racemosa		x	x	x								x
Tournefortia sp. 1												
Trichilia sp. 1												x
Trichostigma sp. 1												
Tournefortia hirsutissima			x									
Vitis biformis					x	x	x	?				
Vitis tiliifolia					x	x	x					
Sp. 1	x											
Sp. 2	x											
Sp. 5										x		
Sp. 6												
Sp. 7								x			x	
Sp. 8												
Sp. 9												
Sp. 10				x								
Sp. 11		x								x		
Sp. 12												
Sp. 14					x							
Sp. 15						x	x					
Species / month	13	13	10	8	14	7	13	11	11	8	11	11